EVALUATION OF INJURED COMMERCIAL POTATO SAMPLES FOR TOTAL GLYCOALKALOID CONTENT

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ABSTRACT

Stress by physical damage is one of the most significant factors which may cause an increase in potato glycoalkaloids. A high percentage of potatoes available on the retail market are physically damaged and possibly are subject to an internal build-up of glycoalkaloids. To investigate this possibility, analyses for total glycoalkaloids were carried out on damaged potatoes purchased on the retail market. Four separate purchases of three different potato varieties were tested. From this limited sampling it cannot be concluded that no tubers containing a high level of glycoalkaloids due to physical stress reach the retail market. However, in the cross section of damaged potatoes analyzed, in no case was a dangerous level of glycoalkaloids observed.

INTRODUCTION

GLYCOALKALOIDS are constituents of potatoes that have been implicated as a causal factor in human poisoning when consumed in sufficient amounts (Bömer and Mattis, 1924; Gull, 1960; Nishie et al., 1971). Factors that affect the levels of glycoalkaloids in potatoes include exposure to light, types of soil, fertilization practices, climate, tuber size, maturity, and damage (Sinden and Webb, 1974). Several studies on the accumulation of glycoalkaloids due to stress by physical damage have appeared (Locci and Kuć, 1967; Wu and Salunkhe, 1976). In a recently completed study (Fitzpatrick et al., 1977), we found that the total glycoalkaloid (TGA) content increased markedly in potato slices incubated at room temperature for 4 days.

With these factors in mind, we observed the high percentage of potatoes on the retail market that have sustained at least some physical damage and thus are subject to internal build-up of glycoalkaloids. Therefore, we procured samples of several potato varieties that had sustained damage sometime between harvest and the time they were made available for sale and ran controlled studies on their total glycoalkaloid content. Since the only control for a study of TGA accumulation in damaged tissue would be undamaged tissue from the same potato, we selected those which had most of the damage confined to one end and used the opposite end for a control.

MATERIALS & METHODS

THREE CULTIVARS of potatoes, Katahdin, Russet Burbank and Red Pontiac were used in this study. Four samples (ca 3 lb) of each cultivar were used. Each sample was purchased from a different retail outlet, half being chain supermarkets and half smaller neighborhood stores.

The potatoes from each sample were scrubbed, dried and arranged in a row from the largest to the smallest. The selection of every third one for analysis gave a representative aliquot (ca 4–5 potatoes) of each sample. Having selected the damaged tubers so that the mechanical damage was confined to one end (but with no particular observation as to whether this was the bud or stem end), the undamaged end of each potato was used as a control in reference to the damaged tissue, while the analysis of the large portion from the middle of the potato when averaged with the values from the ends would give an indication of the overall TGA value. Therefore the tubers were cut into three sections and the entire section was included in the analysis. For the weights of each section relative to the other two see Table 1. These sections were designated: A for the damaged end; B for the center portion; and C for the undamaged end.

To prevent TGA build-up, the weighted sections were quickly diced, placed in appropriate jars and freeze dried overnight on a lyophilizer. It has been our observation (Fitzpatrick et al., 1977) that decreased temperatures lower metabolism to the point where no increase in TGA would be expected during the freeze drying period. This was evident in the final results. The dry weight compared to the fresh weight gave a close approximation of the percent solids contained in the potatoes. These dried samples were then ground to a fine powder in a Wiley Mill so that a homogenous representative aliquot could be taken for analysis, thereby insuring the proper ratio of cortex to pith. For extraction, an amount of the powder in grams equal to the percent solids (which represents 100g of fresh tuber) multiplied by 0.20 was used, thus making each sample equivalent to 20g of fresh tuber.

These samples were extracted and analyzed for total glycoalkaloids by the method of Fitzpatrick and Osman (1974), which consisted of extracting the tubers with a 2:1 methanol-chloroform bisolvent system

Table 1—Total glycoalkaloid analysis of bruised commercially available potatoes

Cultivar	Sample[a]	Fresh wt (g)	Dry powder (g)	% Solids	mg TGA/100g fresh wt
Katahdin	1-A	112.3	23.8	21	16.5
	1-B	147.7	29.5	19	6.3
	1-C	92.3	18.0	19	13.4
	2-A	65.5	13.6	20	14.5
	2-B	53.8	18.7	34	9.2
	2-C	94.0	11.7	12	8.4
	3-A	97.4	20.2	20	19.5
	3-B	129.8	25.0	19	15.0
	3-C	110.0	22.0	20	11.2
	4-A	61.1	12.4	20	19.3
	4-B	101.0	18.2	18	10.2
	4-C	110.0	20.2	18	10.0
Russet Burbank	5-A	113.0	28.0	24	5.8
	5-B	111.0	24.7	22	1.5
	5-C	110.0	22.0	20	3.1
	6-A	47.0	13.5	28	7.2
	6-B	57.0	13.6	23	1.5
	6-C	59.0	15.0	25	6.1
	7-A	198.5	49.0	24	7.6
	7-B	119.6	23.2	19	2.5
	7-C	88.1	20.0	22	3.3
	8-A	45.2	9.2	20	5.5
	8-B	80.0	16.6	20	1.8
	8-C	40.0	7.4	18	5.3
Red Pontiac	9-A	114.6	21.5	18	5.5
	9-B	123.6	21.5	17	2.3
	9-C	73.4	13.0	17	4.9
	10-A	122.0	21.0	17	6.9
	10-B	95.5	18.0	18	1.8
	10-C	87.5	14.0	16	2.1
	11-A	162.0	35.5	21	7.5
	11-B	133.0	26.0	19	4.6
	11-C	73.0	14.0	19	12.1
	12-A	79.5	14.0	17	6.07
	12-B	73.0	14.0	19	2.58
	12-C	51.0	10.0	19	6.26

[a] A = damaged end; B = center section; C = undamaged end.

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which was separated with 0.8% sodium sulfate. Grinding in a Waring Blendor for 5 min, filtering, then regrinding with fresh solvent for 2–3 min effectively extracted the glycoalkaloids. The procedure used is equally effective on both fresh and lyophilized tissue. An aliquot of the methanol layer was hydrolyzed with 2N H_2SO_4. The aglycones were then extracted into benzene which was taken to dryness, redissolved in methanol, and titrated with methanolic bromphenol blue solution.

RESULTS & DISCUSSION

THIS STUDY showed that at least 10% (and often higher) of loose white potatoes available on the retail market had sustained some degree of mechanical damage. The type of damage was primarily cracks and fissures, with some bruising but with no observable decay.

The results of the TGA analysis appear in Table 1. In all the samples but one (in the Red Pontiac Variety) the solids content of the damaged tissue was higher than the uninjured end because of local suberization. This solids difference was considered in the amount taken for analysis. Also, the TGA content of the damaged portion was higher than that of the undamaged end in all but two replicates of the Red Pontiac variety. The center sections of all but three replicates of the Katahdin variety had lower TGA values than either of their corresponding end sections. The maximum TGA value of every damaged end was below that which would be considered a health hazard. In addition, the weighted average of the TGA values of the damaged, center, and undamaged portions would effectively lower the TGA value to a point well below the level of excessive glycoalkaloid accumulation, which in most cases is considered to be above 20 mg/100g fresh weight.

From the limited number of samples tested one cannot conclude that physical damage may not abnormally elevate the glycoalkaloid content of some potatoes available on the retail market. However, in the representative sampling of damaged potatoes which we analyzed, in no case was a dangerous level of glycoalkaloids observed.

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